

# Measurement Laboratories

*Mário João Capucho dos Reis\**

The Measurement Laboratories (ML) provide analytical services in the area of radioactive control of low and medium activity samples and in measurement of ions in liquid samples.

Together with the Environmental Radioactivity Group (GRA), which is responsible for collection, chemical preparation of the samples and data organization), the ML carries out Portugal's obligations under Article 35 of the EURATOM Treaty which requires member states to conduct national environmental radiological survey annually.

The ML is also involved in research work and provides external analytical services to support industrial and commercial activities.

The techniques used are high resolution gamma-ray spectrometry; gross alpha/beta counting and beta counting of specific radionuclide using gas flow proportional counters; liquid scintillation and alpha spectrometry. Ion chromatography is also used to assist in the evaluation of the residual beta activity and in characterization of liquid samples.

In 2008 the range of radioactivity measurement services provided includes:

- Assessment of occupational exposure to  $^{125}\text{I}$  and evaluation of the effective dose of ITN workers;
- Analysis of radioisotopes in water to assist in the surveillance of ITN's research reactor;
- Control of foodstuff, export or import products and building materials;
- Analysis of gross alpha/beta and  $^3\text{H}$  activities in drinking water (in collaboration with the GRA);
- Measurement of  $^3\text{H}$  in biological samples by liquid scintillation for cancer research; and
- Alpha spectrometry on water and soils samples.

In 2008 ML was involved in the following research projects:

- Project *KADRWaste*, involving gamma spectrometry and ion chromatography (a new ultra-low background HPGe detector was acquired on the framework of this project);
- Collaboration with the Aveiro University on the geochronology of sediments using nuclear techniques.

During this year, a plastic scintillator was acquired in order to implement an active background reduction technique (veto detector for the ultra-low background detection system) on the gamma spectrometry laboratory.

During 2008 the ML participated in several intercomparison exercises with good results.

Finally, the staff from the ML was actively involved in the preparation of the accreditation process of the radioanalytical techniques, according to the ISO/IEC 17025 standard, namely the:

- Definition of procedures and organization of equipment records;
- Participation on the "Technical and Management Requirements" working groups, and;

Regarding the training and education, during 2008:

- One group member initiate a post-graduation training programme (DFA) on Radiological Protection and Safety, at IST (Technical University of Lisbon);
- A student from the FC/UL (Faculty of Sciences, University of Lisbon) finished the final-year training in Physics in the ML.

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## Research Team

### Researchers

\*M. REIS (from June), Aux.

### Analysis Contractors

L. SILVA, physicist

J. ABRANTES, physics engineer

L. TORRES, chemical engineer

### Technical Personnel

J.M. OLIVEIRA, Senior Technician (30%)

G. SILVA, Technician [1\*]

### Informatics Consultant

J.P. SARAIVA (until June)

### Students

G. CARVALHAL, FCT grantee

R. MENDES, FC/UL graduation student (until September)

## Geochronology of sediments using nuclear techniques

*L. Silva, N. R. Pinhão*

### Objectives

During four decades (1950-1994), Ria de Aveiro was subject to continuous discharges of mercury-rich effluents from a plant located in a chemical complex industry upstream.

Vertical profiles of mercury concentrations of salt marsh sediments colonized by plants and sediments without vegetation of Laranjo Bay (a semi-enclosed bay) shows a sub surface maximum at different depths along the contaminated bay. The main objective of this work was the study of sediment chronologies based on  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$  profiles in order to correlate the peak of mercury concentration with the industrial activity.

### Results

The  $^{137}\text{Cs}$  data show a maximum around 30-40, 20 or 50 cm respectively for stations A, B and C identifiable with the Chernobyl accident of 1986 and very close to the maximum of mercury concentration in each station. Assuming a constant sedimentation rate, we can make a first estimate of the sedimentation rates in 1.43-1.9, 0.95 and 2.38 cm/yr respectively for stations A, B and C.

Except for the first value in stations A and B, the unsupported  $^{210}\text{Pb}$  values show a relatively smooth behavior. Also shown are the regression lines obtained

using an exponential model with weighted uncertainties but neglecting the first value in stations A and B. Using the CRS model the sedimentation rates are  $(1.25 \pm 0.41)$  cm/yr,  $(0.88 \pm 0.49)$  cm/yr and  $(2.24 \pm 1.01)$  cm/yr respectively for stations A, B and C. Although the relative uncertainty is high in all cases, the values are consistent with the previous estimates from the  $^{137}\text{Cs}$  data and the mercury observations.

The study of  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$  profiles has provided chronostratigraphic information consistent with previous estimates from mercury profiles and the known history of the industrial activity in the area. It was confirmed that the area of station C exhibits the highest sedimentation rate, followed by station A.

### Published Work

M.Válega, L. Silva, N. Pinhão, A.I. Lillebø, E. Pereira, A.C. Duarte and M.A. Pardal, Historical reconstruction of mercury contamination in Laranjo bay, Proc. of the International Conference on Radioecology & Environmental Radioactivity, 15-20 June 2008, Bergen, Norway

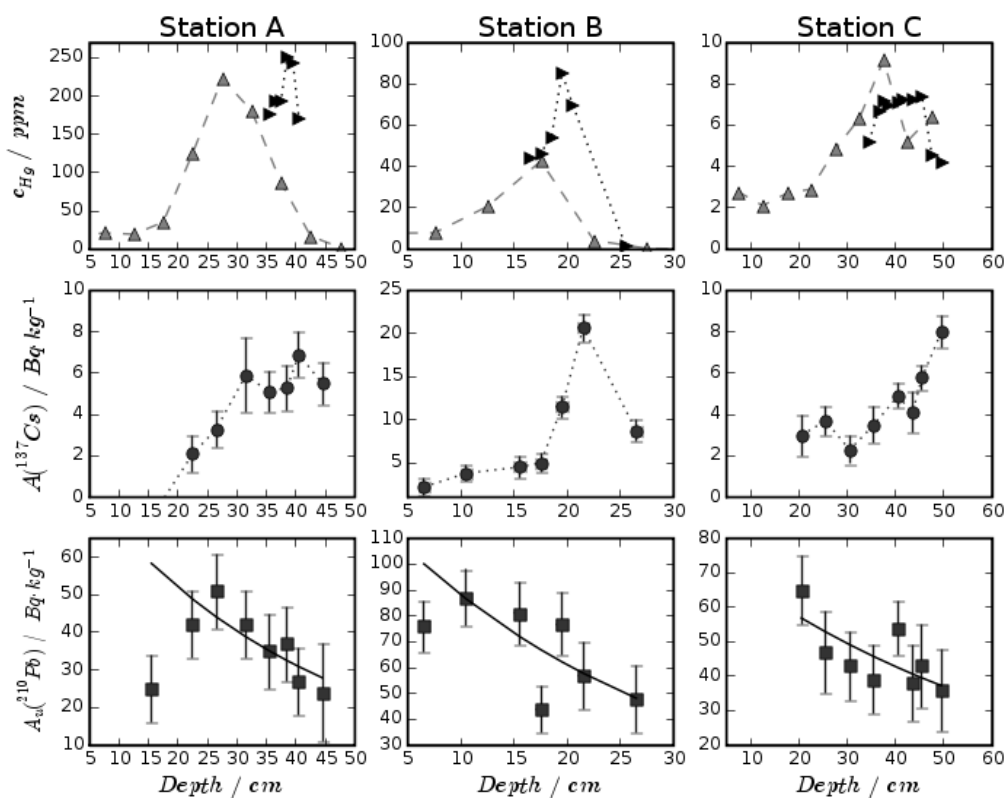


Fig. 1. Subsurface distribution of Hg and  $^{137}\text{Cs}$  and  $^{210}\text{Pb}$  activity in the three sampling stations

**<sup>125</sup>I measurements for occupational exposure assessment**

*L. Silva, N. R. Pinhão*

In order to assess the level of occupational exposure, individual monitoring of workers handling <sup>125</sup>I was carried out by using high resolution gamma spectrometry. X-ray and gamma spectra of urine samples were analyzed and the K<sub>α</sub> and gamma peaks were used to quantify the activity of the samples in order to estimate the committed effective dose by inhalation of <sup>125</sup>I. For a 24-hour excretion period the committed effective dose was estimated to be less than 0.3 μSv.

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**SERVICES**

**Analytical Services on Radioactivity Measurement and Liquid Ion Chromatography**

*J. Abrantes, G. Carvalhal, J. M. Oliveira, N. R. Pinhão, M. Reis, L. Silva, G. Silva, L. Torres*

In 2008, around 4000 analysis have been performed (excluding analysis for calibration, quality control and intercomparison exercises) involving the following techniques: alpha spectrometry (40%), total alpha or beta counting techniques (12%), gamma spectrometry (30%), liquid scintillation (15%), and ion chromatography (3%). The above mentioned analysis were carried out in the framework of the national environmental radiological survey, as services for external entities and for research projects, either of UPSR or other ITN sectors. The services provided to external entities represent a net income for ITN of over 90 kEuros.

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